IMPROVING TESTING AND MEASUREMENT IN INDUSTRIAL ARTS

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D.W.V.

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CHAPTER I

THE PROBLEM: ORIGIN AND DESCRIPTION

The developments of the past several decades have shown that the industrial arts teachers need to have more knowledge of tests and their construction to use in their classroom and shop. Until recently testing in industrial arts has, on the whole, been very unsatisfactory. The Manual Arts teachers, as did the teachers in general education, tried to evaluate the students achievements solely on subjective types of tests. Because manual arts work was manipulative in nature, little thought was given to the informational phase of the materials, tools and processes. Teachers concentrated on tool usage which did not lend itself to the subjective forms of testing. Student achievement was measured not on the knowledge he acquired, but on the effort exerted on projects such as footstools and flower stands. Efforts to measure any phase of manual arts except manupulative skills was neglected.

However, the recent trend in industrial arts testing and measurement has been more progressive. With the teacher informal objective test replacing the traditional essay test, the industrial arts teachers found that students achievement could be measured more objectively. The industrial arts teachers find that there is now a large assortment of the same types of tests, formerly used in purely academic subjects at his disposal. The students may be given prognostic tests, intelligence tests, achievement tests or diagnostic tests and have them specifically adapted to industrial arts subjects. Through the use of the tests, the teacher discovers whether or not the student has mechanical ability, can check on the students' progress, and check the students' achievement

in comparison with other schools by using the norms which accompany such tests. If the teacher needs to measure progress in a particular situation, he must be able to construct a test that will be a valid and reliable check of the student's knowledge. Teachers in industrial arts must remember the student must not only have the ability to do the work, but must also know the fundamental processes behind each job.

Origin Of the Study. The author realizes that industrial arts teachers must know the fundamental principles of scientific test construction and interpretation to have an adequate testing program in their classrooms and shops. If industrial arts is to fulfill its rightful place in general education, it must have a better understanding of the means of measuring its pupils' achievement and difficulties. The fact that subjective type of measurement has proven unsatisfactory leads to the question, "how can testing be improved in industrial arts?" This question has led the author to attempt to determine in this study how measuring devices, such as tests, and testing programs can be improved in industrial arts subjects.

Need for the Study. From the effects of the subjective type measurement used in the past, the author is sure industrial arts teachers realize the need for other types of measurement. Industrial arts being a relatively new field in general education, the teachers should take advantage of the mistakes made by teachers in the academic subjects. The industrial arts teacher should be ready to accept or reject any new or better means of measurement which may be used in industrial arts. They should also, when possible, try to improve on any method which will measure their student's achievement better than the instrument they are using.

The purpose of this report is to acquaint the industrial arts teacher and future teachers with the progress made thus far in testing in industrial

arts. The author hopes to point out to the industrial arts teachers how they can improve any existing testing program which they may now be using. The author also hopes to acquaint the teachers with standardized tests which are now at their disposal.

Methods of Research. The study of books, pamphlets, bulletins, and other literature provided the chief source of information used in this report. Other than the annotated bibliography of the standardized tests found in the last chapter of this report, complete reliance is placed on the library technique of research. The standardized tests were obtained by sending letters to twenty-three commercial testing bureaus. Of the twenty-three letters sent, twenty-two replies were obtained.

Definition of Terms. In this study certain terms are used in such a way that definitions of them should prove helpful to the reader. The definitions given here are quoted from the writing of recognized specialists in the field of tests and measurements and industrial arts.

> Industrial Arts. The changes made by man in forms of materials to increase their values, and the problems of life related to these changes. (3 - page 5)
>
> Industrial Arts is a group of school subjects that deal with industry and with the effects of industrial development on the home and social life of the individual, and with the manipulative processes and industrial materials which have become an essential part of the social culture. (23 - page)
>
> Test. Generally speaking, a test is a measuring instrument used for the evaluation of a knowledge, quality, or ability. (12 - page 12)
>
> Achievement tests are those tests which measure pupils' mastery of subject matter taught in school. (4 - page 14)
>
> Prognostic Tests. These tests are intended to be used as pre-tests to determine beforehand the probable interest in, aptitude for, and likely success of an individual in the field, such as any occupational field which he contemplates entering. (8 - page 175)
>
> Diagnostic Tests. The diagnostic and analytical tests are designed to reveal specific elements of strength or weakness in learning or in teaching. (24 - page 429)

Standardized Test. A test is standardized (1) if it is composed of exercises that have been selected in the light of usual teaching practice and evaluated as to inate difficulty, and (2) if it is accompanied by norms or standards permitting the interpretation of results in levels of accomplishment. (12 - page 13)

Informal Objective Test. Most tests used by teachers are of this type. These tests are similar to standardized tests, but differ from the latter in that norms have not been made available for them. Their validity and reliability usually have not been determined scientifically. They can be easily adapted to the local requirements, and they may be more fair or valid than a standardized test in that they may better cover what was actually taught. (24 - page 427)

Norms are representations of the typical or average performance of subjects of different age or grade groups. Usually based on a large number of cases. (12 - page 246)

Subjective. The score a student made depended very largely upon the personal opinion of the scorer and the factors which he considered essential to scoring. This method of scoring or grading is called subjective, and it is not very accurate. (15 - page 2)

Objectivity. By objectivity in a measuring instrument is meant the degree to which equally competent users get the same results. (16 - page 88)

Review of Similar Studies. The author, after an extensive study of past master's degree theses, educational bulletins, books and other library sources, was forced to conclude that similar studies on testing in Industrial Arts have not been attempted or are not available at this time. This, if true, reinforces one of the recommendations found in the last chapter of this study, in which the author recommends that more studies of this nature should be attempted

Available Literature on this Subject. The author found and investigated a very large number of books involving testing in general education. A large part of the basic material found in this report was taken from these books. The author found, however, that books dealing directly with testing in industrial arts and industrial education could be found only in limited numbers. Emanuel E. Ericson, Louis V. Newkirk, Harry A Greene, John F. Friese, and F. Theodore Struck are the leaders of this field at the present time. McGraw-Hill publishing

company will soon publish a new book on industrial arts testing written by Dr. William Micheels at the University of Minnesota and Ray Karnes at the University of Illinois. This book, though not available at the present time, may answer some of the problems facing teachers in industrial arts.

Predicted Views of the Results of this Investigation. The following outcomes of this report are predicted by the author. (1) To make for better understanding of tests and measurements and their theory and practices; (2) that the information will serve as a guide in any proposed testing program in industrial arts, and (3) that this study may inspire industrial arts teachers who are not familiar with new testing techniques to examine their program for possible points of improvement.

A preliminary study of the history and development of tests and measurements in industrial arts is necessary before proceeding to the present day testing techniques.

CHAPTER II

HISTORY OF TESTING IN INDUSTRIAL ARTS

The discussion of this chapter traces industrial arts testing from early historical records up to the present time. This measure can be roughly divided into the following three periods:

(a) Early history of industrial arts testing.

(b) Industrial Arts testing between World War I and World War II.

(c) Present day status of industrial arts testing.

During the first period, early history of testing, educational measurements were very crude. A glance at the evolution of the arts shows that from the earliest times when man began to use his hands for productive occupations, the only types of tests used were tests of utility. Little progress in industrial arts testing was made before World War I. During the second period between World War I and World War II, group tests made their appearance during and immediately following the end of World War I. The period from 1918 to 1941 was marked by the publication of many tests and a general upsurge of interest in testing in industrial arts. The brief third period, present day testing, is characterized by tremendous advances in techniques in the measurement of achievement, aptitudes and ability. There has been an increased clarity of thinking concerning the proper use and improvement of all types of tests.

PART A

Early History of Industrial Arts Testing. Tests and measurements of one kind or another have played a far more important role in history than is

generally recognized. The earliest form of education centered around such problems as those of securing food, providing shelter and making clothing. The father or the mother was the instructor and the method used for instruction was that of demonstrating and practice on the job being worked upon. The test of this period was the test of utility. Later came the period of a more or less organized plan of training known as the apprenticeship, which dates back to the ancient civilization of Babylon and the old Greeks. During this period of learning, the tests were based on how well an apprentice learned his trade by the constant hours of practice.

The earliest form of testing used as a part of the classroom procedure was oral. Although the tests were simple tests of memory and motor processes and largely theoretical, they were the educational measurements of their period. Socrates, in a method he made famous, subjected his pupils to exhaustive and searching questioning. In medieval times, the oral examination was used in the universities. The University of Balogona by 1219 A.D. and the University of Paris required candidates to defend their theses orally.

As early as 2200 B. C. China had an elaborate national system of written examinations for the purpose of selecting their public officials. These examinations have been known down through the ages for being severe. The candidates were confined to isolated cells and compelled to write long papers on assigned topics. Written examinations in universities probably made their first appearance at Cambridge, England in 1702.

The theory and practice of testing in the industrial subjects assumes a manner so evasive that it is difficult if not impossible to locate definitely its origin and method. Through each period of advancement for the movement of manual and industrial education, the testing consisted of copying and imitating models produced by the instructor, performance tests such as squar-

ing a board or subjective grading by the teacher and informal teacher made tests. In early periods there is mention of the pupils acquiring certain skills in the manipulation of tools or materials.

J. A. Comenius in his plans for a Pansophic School at Saros Patok in Hungary says:

> Skill in action is to be associated with knowledge of things. Without this skill even he who knows much about things will be awkward in dealing with them; . . . No one will be graduated from the institution who is not well trained in those occupations which demand care and circumspection. (5, page 9)

J. J. Rousseau in his publication Emile in 1762 said:

> He is ready for anything. He can handle a spade, and hoe, he can use a lathe, hammer, plane and file; he is already familiar with these tools which are common to many trades. He only needs to acquire sufficient skill in the use of any one of them to rival the speed, the familiarity, and the diligence of a good workman. (17, page 159)

The Sloyd system of hand training, established by Otto Salomon and Herr Abrahamson in Sweden in 1872, had a very marked influence in the development of manual education in America. The students of this system worked on a series of fifty models. Each model was detailed, not only as to dimensions, kind of wood, and tool processes involved, but for each model the educational values were clearly stated such as: training in skill, dexterity, neatness, attention, accuracy, aesthetic sense, patience, honesty, perseverance and love of labor. Although the Sloyd system had its defects, its methods of grading projects was the most objective the author found in the early manual education history.

In the Teacher Training College in Boston in 1890-91, certificates of qualifications to teach Sloyd were issued by the school to graduates approved by an examining committee. The requirements for the certificate were:

1. The satisfactory completion of 25 models.
2. Proof of ability to make and use working drawings, and of skill in the sharpening and care of tools.

3. Evidence of teaching ability.
4. A short essay on the theory and educational value of manual training written in class. (2, page 472)

Not only did the prospective teacher have to prove his skill in performance tests on his models, but he also had to demonstrate his ability of caring for the tools used and further prove his ability to write by passing essay type tests on manual training.

It was also interesting to note in Ray L. Southworth's article in his 1910 Manual Training Magazine the suggestion of keeping a notebook in manual training. The following is quoted from the article:

> The notebook work should be made interesting and its value in the present making or future reference should not be underestimated by teacher or pupil. It is recommended that the notebook . . . be used, so that the pupil, going from one school to another during his high school course or entering a higher institution after completing any high school course, may present his notebook, with the instructor's signature to the institution just entered. This evidence with some oral questioning upon the fundamental principles of the subject, should insure the students receiving full credit for work already completed and at the same time protect the institution. (22, page 237)

The last two reasons given for keeping the notebook are very important. If the instructor used the notebook to determine the student's ability and how much information he received from the last school attended, he could predict to some extent the pupil's progress in his shop.

The first standardized aptitude tests were developed by H. Munsterberg in 1913. These were tests for telephone girls and streetcar motormen. These aptitude tests were later followed by tests for mechanical aptitude, musical aptitude, art aptitude and clerical aptitude. But the great development of any form of standardized tests which could be used in industrial arts did not appear until after the first World War.

PART B

Industrial Arts Testing Between World War I and World War II. The year 1917 found the United States in World War I, faced with the urgent necessity of training a large civilian army. The existing individual tests were entirely unsuited for use with illiterate and foreign-speaking recruits. These tests were also too slow as there was neither time nor examiners to test the thousands of men needed.

In 1917, a group of psychologists, including Robert Yerkee, A.S. Otis, G. M. Whipple and G. A. Yoakam met in the training school, Vineland, New Jersey, to develop the Army Alpha test which was the first group intelligence test to be published. The difficulty of time was solved because a group test could now be administered to a hundred or more individuals in the time it formerly required for measuring one individual. The Army Alpha test was used for testing men who could read and understand English. The test was made up of a series of eight tests with a series of tasks or problems in each test. These tests were planned to measure mental development through the ability to understand, to carry out instructions, to organize disarranged words to make complete meanings, to observe and detect differences and similarities, and to retain and interpret information learned through common experiences. The manual of instructions and the mechanics of the test were very simple so that any skilled examiner or teacher could, with a little study, qualify to give the tests with satisfactory results. Accompanying the Army Alpha test was the Army Beta test. This test was a non-language test used to test men who could not read or write English. This test was a performance type of test. All directions were given in spoken words or pantomime until the men understood what they were to do with the test. This type of test consisted of tracing

mazes, indicating whether groups of numbers were alike or unlike, supplying missing elements in pictures and the manipulation of apparatus such as form boards. The form boards consisted of blocks of various shapes cut out of a board and the test was to fit them in their proper place in the board. The solution of the test depended upon the actual performance with the different parts of the test and not on the linguistic ability of the men.

In addition to the alpha and beta tests, the army also developed a number of standardized tests for measuring trade ability. The tests were largely tests of skill and trade information. The methods of approach, the type of problems devised, methods of scoring and the ratings gave the field of manual arts an excellent key to similar research problems.

The technical department of Chicago high schools, following the war, attempted to apply some of the methods used by the army mental and trade performance tests. The functional principles and operations required in the courses of woodwork, machine shop, printing, etc. were analyzed and tests were then devised based upon the theory and practice of each of the subjects. The subject of woodwork because of the great numbers of pupils enrolled in the course, received the greatest attention. Two types of tests were devised: A trade knowledge test and a trade skill test. Both tests proved satisfactory with the exception of the trade knowledge test which proved too easy and required revision.

Although this was a great stride in testing in industrial arts, the teachers first regarded this study with suspicion. They thought that this was a procedure to show up a teacher's inefficiency and to increase his work. However, after the tests were made and the teachers had an opportunity of assisting in scoring the papers, they soon became interested in the problem. They recongized that this type of an inventory would be of assistance to them

in determining standards of attainment.

The development of standardized tests was very rapid in the period from around 1920-1941. However, as late as 1927 the scientific measurement movement had as yet scarcely made itself felt in the field of industrial arts. The difficulties of placement in the school curriculum and content of material have undoubtedly operated in the field of industrial arts. Added to these obstacles are such others as the relative emphasis that should be given in a particular subject to skills and related materials, the amount of time that should be devoted to industrial arts work, and the lack of agreement as to what standards of attainment the pupils should possess upon completion of a given unit of work.

Mechanical ability testing, though older than intelligence testing, has been almost entirely neglected until recent years. A research in mechanical ability, carried on at the University of Minnesota in 1923-1927 was one of the several supported by the National Research Council in its studies on immigration problems. The purpose was to devise methods of prognosticating mechanical ability, and to suggest ways and means of adapting these methods to practical use in schools.

In 1927, John Stenquist developed the "Stenquist Mechanical Aptitude Tests," which were tests on mechanical things common in the experiences of most people.

G. M. Ruch published his book in 1924 entitled "The Improvement of the Written Examination" on informal tests constructed by the teachers. The informal objective tests between 1920-1936 came into such wide use that J. M. Lee and David Segel, in 1936 made a survey entitled "Testing Practices of High School Teachers." Of 1600 high school teachers, widely distributed throughout the country, 74 per cent used informal objective tests and an additional 10 per cent used a combination of the informal objectives and essay examination. This type of test was, and still is, especially useful in industrial arts in

the evaluation of the classroom achievement because the content of the test parallels the subject matter taught to the class.

When, in 1941, the United States found itself at war, industry and the armed forces found the tests which had been developed in the past twenty years invaluable. Not only were men and women needed for both industry and the armed forces, but they were needed in such great numbers never heard of before, and in the shortest possible time. By using the scientific measurements developed over the years, both groups were able to choose and make the best use of the individual talents of the available men and women.

PART C

Present Day Status of Industrial Arts Testing. The present day development of valid and reliable tests is not only the development of new tests to be used in industrial arts, but is also a better understanding of the proper use and improvement of the available tests which can be used to measure subject matter and tool skill. Whether the teacher uses standardized tests or teacher constructed tests, it is their responsibility to properly interpret the results. If standardized tests are used, and by making use of the norms which accompany the tests, the teacher will have a basis for the practical interpretation of the meaning of the test results. If the informal test is used, the significance of the results will depend on how objective or subjective in character the tests are constructed. Industrial Arts teachers have come to realize the importance of ability tests, achievement tests, and prognostic tests in the planning and operating of classroom and shop instruction. The tests should serve as a guide and compass, which will enable the teacher to direct the educational program with a minimum of lost motion.

Standardized tests are not yet available for all purposes. With added

research, more and better measuring instruments may be available for use in Industrial Arts. Although properly constructed standardized tests are superior in certain respects to teacher made tests, they will probably never entirely displace them as a means of measuring the results of teaching. The teacher, especially in Industrial Arts, will always have need for a measuring instrument adapted to a particular course of study or to emphasize some point of instruction of a particular class subject.

CHAPTER III

TYPES OF TESTS USED IN INDUSTRIAL ARTS

The classroom teacher must be able to prepare and use valid and reliable examinations of all types in order to analyze and to evaluate properly the products of their pupils' learning. The two most common classifications of educational tests are the essay-type or subjective and the objective type examinations. The author has also included in the objective classification of tests the standardized and the informal objective, which are very similar in structure and are both forms of objective measuring instruments.

Each of the types of tests has its peculiar characteristics, advantages, and limitations. Whether one is superior or inferior to the other can only be judged from the specific ends to be attained by each. To say that all are good or bad is quite impossible. The teacher can only determine what type of measurement to use efficiently by what specific objectives are to be accomplished in the classroom instruction.

PART A

Subjective Test. The traditional method of measurement in education has been the subjective or essay test. In this test there are usually a limited number of questions. The student has relatively free range in the content, length, and style of his answers. This type of test frequently asks the student to name, to locate, to discuss, to evaluate, to distinguish between, to define or describe, to illustrate or explain, to give reasons for or causes of, or otherwise respond to more or less definite issues. Too frequently these

questions are so broad and involve such complexities that pupils cannot give adequate responses in the time allowed. Some essay questions are sufficiently definite that the responses may be evaluated objectively but others are so general that the responses can be rated with reasonable accuracy only by the use of a definite scoring rule or some similar method. Although the elimination of subjective grading and testing in industrial arts will greatly improve the general field, it has been recognized that certain products of the classrooms and shop do not lend themselves readily to the objective form of testing. When the subjective type of test is used in industrial arts, the instructor must carefully construct the test so that the results will be fairly reliable and the test responses so objectively prepared that personal judgement by the scorer will be kept to a minimum.

Louis V. Newkirk has the following to say about essay tests.

> All teachers are familiar with the ordinary examination in which five or ten questions are asked, to which the pupil responds as best he can. These questions are easily prepared; in fact, they can be thought of after the teacher begins to write them on the board. But they are not so easy to score. The latter process requires long hours of laborious reading, evolving finally in a highly general and subjective estimate of the worth of the papers. (11, page 165)

Emanual E. Ericson says:

> To progressive teachers of shopwork, the use of written or "paper" tests is not new. The old type or essay form of examination has been of limited value, however, in this field for determining pupil progress and achievement for two reasons: (1) A great many students who are vitally interested in mechanical work are not interested in essay writing; and (2) ability to write essays does not necessarily indicate efficiency in this type of work. (7, page 206)

Types of Essay Examination. The author, after an investigation of a number of books on testing in general education, found that there are at least twenty different classifications of the essay type examination, however, not all of the classifications are applicable to industrial arts testing, so only the following have been included.

Simple Recall

Samples:

1. Name four different saws used in woodwork.
2. Name three different cutting tools used in woodturning.
3. Name four types of wood stains.

Comparison of Two Objects

Samples:

1. What is the difference between walnut wood and oak wood?
2. How does the mortise gage differ from the marking gage?
3. How does the jack plane differ from smooth plane?

Description

Samples:

1. Why must oak wood be filled?
2. For what reason is the gouge tool used in wood turning?
3. Why is walnut a good cabinet wood?

Procedure

Samples:

1. Give the procedure for preparing S_2S stock to finished size.
2. Give the steps in applying a french polish.
3. Give the procedure for preparing rough stock to finished size.

Advantages of Essay Examinations. The essay type of examination has some advantages as well as disadvantages. The two most important advantages are -- ease of construction and administration and measurement of higher mental abilities. These advantages will be discussed briefly.

a. Ease of Construction and Administration. Essay tests are easy to construct and administer for teachers know the nature of the

~~of the~~ essay test questions to be used. Because of this, teachers typically prepare essay questions in a minimum of time, sometimes immediately before the test is to be given. Little or no time is needed for telling the pupils how to take the essay test as the pupils know the traditional methods of answering them.

There seems to be much disagreement among authors as to whether this is an advantage, however, most of them have listed it as an advantage. It is an advantage only, if in the minimum amount of time the teacher constructs an essay test which tends to be fairly valid and reliable and follows the other features which characterize a good test.

b. Measurement of Higher Mental Abilities. The purpose of the essay test is primarily to ascertain, not if the student knows this or that in particular, or has done routine work well, but if he knows accurately a considerable amount and understands a variety of facts and has the ability to interpret them. In short, the questions are devised to test the pupil's ability to make use of knowledge. This is especially true for advanced students, for whom the testing of such types of higher abilities is more important than the testing of the broad fields of factual knowledge.

Disadvantages of the Subjective Test. Two disadvantages of the essay test are, (1) the factor of limited sampling, and (2) subjectivity of scoring are discussed in the following paragraphs.

a. Limited Sampling. The essay test consists of only a few questions. The instructor cannot hope to secure a wide sample over any sizeable field of subject matter in the shop from the five or ten questions usually asked. The test can measure only over a few of the important

areas in which the student's abilities should be tested. This disadvantage can be overcome only if more questions are used over a wider field of subject matter and so worded that short, to-the-point answers will be sufficient to answer the question.

b. Subjectivity of Scoring. The second disadvantage of the essay test is the subjectivity of scoring. It is hard for the teacher to score the essay examination because the answer is an entanglement of subject matter, spelling, grammar, and handwriting. Also the teacher may unknowingly allow his knowledge of, or attitude toward the student to affect the final score given the test answer.

Many studies of the subjectivity of scoring of the essay test have been developed in the past thirty years. All of the studies showed the lack of objectivity in the measurement of the essay test to vary from teacher to teacher, grade to grade, school to school. The establishment of uniform standards of achievement in the teacher is probably a human impossibility. The remedy lies in giving the teacher a tangible unit of measurement.

To eliminate the subjective scoring in essay tests, the teacher should work out a definite key for scoring the test. Such a key will give the specific score points to be given as credit for each part of each answer. The students' names should be written on the backs of the papers so no personal feeling of the teacher will enter into the grading.

PART B

Objective Tests. An objective test is an examination in which every response is either correct or incorrect from the point of view of truth or fact. A good objective test permits no opportunity for subjective opinion or personal judgment in its scoring.

Lewis V. Newkirk and Harry A. Greene define the objective test as follows:

> Objective exercises are marked by two important and related features. These are (1) brevity of pupil response, and (2) absence of personal judgment in scoring the test exercises. (12, page 11)

Theodore Struck defines the objective test as follows:

> An objective test is one which is free from personal judgment in scoring. It is a test so devised that the same score will be given by any competent examiner or by the same examiner at any time. (24, page 426)

Securing Objectivity. Objectivity in the test may be secured in several ways. First, directions must be given to the students in words readily comprehensible to the student taking the test. The directions must be briefly and completely stated; and should include a sample illustration showing the student how to respond. Secondly, no question which is debatable as to its truth should be included. In the third place, the phrasing of the questions must be so clear and certain that not only does the student respond to the test correctly, but also that there is no allowance for disagreement among different examiners. Finally, a scoring key should be provided containing the correct answers, with only one correct answer for each question.

Since the objective form of testing permits rapid response covering a wide sampling of test material, it is advisable to limit the amount of writing that the student must do. The responses may consist of checking, underscoring, or encircling words or phrases. In the completion exercises, the response should be kept to a minimum. The students become involved in

conflicting facts or thoughts and wrong responses are given.

Types of Objective Examinations. The main types of objective examinations which have been prepared and widely used fall into the following classifications:

I. Recall types:

1. Simple recall questions
2. Completion exercises

II. Recognition types:

1. True-false
2. Multiple response
3. Matching exercises
4. Rearrangement exercises

III. Performance

1. Quality, or accuracy
2. Identification of tools and materials
3. Technique
4. Speed or rate of response

The type of objective tests to be used depends on the information and manipulative ability that is to be tested. The type of question to be used, then, must be suitable to the information being tested. The many types of objective tests should be carefully studied by the instructor. Then the type or types which best measure the different phases of information and manipulative ability should be selected for use by the instructor.

Recall Exercises. In the recall type of test the learner must recall or remember the correct response. The common forms are known as the simple recall test and the completion test. In the construction of the recall exercise the test maker should construct definite sentence statements with the central fact or word omitted. This avoids any answers the students might

give from their general information, possibly without any specific knowledge of the subject matter. Recall exercises have great value in industrial arts to test for information, but of less value in testing manipulative activity.

The simple recall examination is a one-blank-per-question completion test with the answer blank usually provided at the right of the statement. The answers are not suggested or given, but must be recalled. It differs from the sentence completion in that it does not require the completion of a sentence that is, the recall is not within a sentence.

Simple Recall Sample

Your Name _____ Date _____ Score _____

Directions: Below are a number of sentences. Each needs one word to make it a true statement. This word is the last in each of the sentences. Write the missing word on the line provided at the right.

0. Columbus discovered America in . . . . . (0) 1492 .

---

1. Nails hold better when driven at an . . . . . (1) ____.
2. When the plane is not in use, lay it on . . . . . (2) ____.

The completion type test is made up of incomplete statements in which important, or key words, have been omitted. The test will have one or more blanks in the sentence.

Completion Sample

Your Name _____ Date _____ Score _____

Directions: Below are a number of statements with one or more blanks. The statements are to be completed by adding one and only one word in each blank.

0. In 1492 Columbus discovered America.

---

1. The _____ works as a crank and holds the bit when boring holes.
2. One mark should be placed on the _____ _____ to identify it from the others.

Recognition Exercises. Recognition exercises are those in which the answers are furnished to the pupil. It is his responsibility to decide upon the accuracy of the statements, upon one of several possible answers which is correct, upon relationships existing among lists of items, or otherwise deal with the material presented to him.

The true-false test is the most widely used alternate-response type test and are those questions having only two alternative answers presented to the pupil for his response. All statements included in the true-false test must be definitely true or false.

True-False Sample

Your Name _____ Date _____ Score _____

Directions: Some of the statements in this test are true, and some are not true. Read each statement carefully. If you think the statement is incorrect or false, underline the F. If you think the statement is correct or true, underline the T. The sentence below is a sample.

Example:

T. F. 0. Columbus discovered America in 1492.

T. F. 1. The junior jack plane is larger than the jack plane.
T. F. 2. Kerf refers to the notch or groove made in the board by the saw.

The multiple-response type of examination includes items in which incomplete statements are given followed by two or more alternate answers, only one of which is correct. When the correct response is given by the student, the item makes the statement complete and correct. This type is fairly easy to grade as a simple window stencil may be used, but hard to construct as there is the danger of having more than one correct or nearly correct answer among the alternate responses.

Multiple-Response Sample

Your Name _____ Date _____ Score _____

Directions: Each of the statements below are answered correctly by one of the words following the statement. Determine which of the choice of words correctly answers the statement, and underline the word.

Example:

0. In 1492 Columbus discovered (a) India, (b) Africa, (c) America (d) China.

---

1. Wood filler is essential in finishing, (a) oak, (b) maple, (c) poplar, (d) basswood.
2. One kind of nail most commonly driven below the surface is, (a) box nail, (b) casing nail, (c) roofing nail, (d) shingle nail.

The Matching Exercise is a form of alternate response test in which the student responding to the test indicates which single item in one of two given columns is paired with one item in the second column. More items should be given in the answer column than is needed to answer the other column. All items should be in alphabetical order in the right hand column. This type is very good to use in industrial arts education for measuring relationships between items of information, materials or tools.

Matching Exercise Sample

Your Name _____ Date _____ Score _____

Directions: Below are two columns of words which are related in meaning. Choose an item from the left-hand column which is best related to an item in the right-hand column and write the number in the blank provided.

Example:

0. Columbus	_____	Civil War
	0	America
	_____	Congress

1.	Alcohol	_____	Garnet
2.	Brace	_____	Dado
3.	Edge	_____	Open grain wood
4.	Joint	_____	Bevel
5.	Kerf	_____	Bit
6.	Nail	_____	Miter
7.	Paste filler	_____	Hammer
8.	Plane	_____	Throat
9.	Sandpaper	_____	Shellac
10.	45° Angle	_____	Saw

The Nose

Screw gage

The Rearrangement Exercise is an alternate response test in which several items are given as one exercise. The task is to number the items in each exercise in correct chronological order, order of operation, and classification of materials as to grade or quality. Each exercise should include only four or five readily identifiable items.

Rearrangement Sample

Your Name _____ Date _____ Score _____

Directions: From the list of steps for carrying out a job listed below, examine each step, and decide which comes first. Place the number in the first parentheses below the list. The first parentheses to the left indicates the first step. In the same way place the numbers of the remaining steps in proper order, so that when you have finished, one can read the numbers in the parentheses from left to right, and find out just how to carry out the steps for the complete job.

Example:

0. To bore a hole with a brace and bit.
   1. Fasten bit in brace.
   2. Withdraw bit and finish boring from opposite side.
   3. Mark location of hole.
   4. Bore through until spur shows on other side.
   5. Select the proper size bit.

   (3) . . . (5) . . .(1) . . . (4) . . .(2)

---

1. Indicate the order in which the following steps should be taken in planing an S2S board to size.
   1. Plane best edge.
   2. Plane edge opposite best edge.
   3. Plane second end.
   4. Plane faces smooth.
   5. Select best face, mark with one pencil mark.
   6. Plane best end.

   ( ) . . . ( ) . . . ( ) . . . ( ) . . . ( ) . . . ( )

Performance Test Exercises. This type of test is the least perfected of all tests. The test is sometimes called the "practical" test. The object of this test is to allow the student to work on materials with tools, to recognize types of materials, and to check the student's responses in an objective manner. With this test both information and ability to perform in shop work may be as accurately measured as information can be measured in academic subjects.

The student is given complete information and method of procedure used to complete the job. The student is then graded on how well he follows directions, his choice of tools and the finished project. Allowances in the plan of scoring must take into account the penalty for errors.

Lewis V. Newkirk and Harry A. Greene list the following types of performance tests:

> Quality or Accuracy Exercises. The quality or accuracy of industrial education work is determined by careful evaluation of materials which have been modified in some significant way with tools, materials, or instruments.
>
> The following guiding principles may be helpful in constructing objective test exercises of quality.
>
> 1. Provide a job which will give adequate samples of the results of the tool or instrument operations being measured.
> 2. Give specific directions for doing the work.
> 3. Provide all tools and materials necessary.
> 4. Measure the results by physical measurements, quality rating scales, and where necessary, by inspection. (12, page 117)

> Identification Exercises. Identification exercises are very useful for testing the pupil's ability to recognize materials, instruments, and tools. They are also used for measuring a pupil's ability to analyze special difficulties. The following significant principles in the construction of identification exercises should prove suggestive to the teacher:
>
> 1. Provide a representative sample of the objectives to be identified.
> 2. Suspend materials so that they can readily be examined.
> 3. Score the items by checking the objective written responses. (12, page 118)

> Technique Exercises. Technique exercises are designed to measure a pupil's method of manipulating tools, machines, instruments, or materials. It is possible to do work of good quality with poor technique, but great skill can scarecely be developed without the fundamental techniques with tools and materials.
>
> The teacher will do well to consider the following guiding principles in the construction of test exercises for measuring technique:
>
> 1. Provide activities which will call for the use of tools or instruments in which technique is to be rated.
> 2. Give specific direction for doing the work.
> 3. Provide enough activity to give adequate samples of the various techniques.
> 4. Provide necessary tools and materials.
> 5. Rate the techniques by using a rating scale. (12, page 120)

> Speed or Rate of Response Exercises. Rate of response is of less

> importance in the cultural courses of the elementary and junior high school. Tests of speed . . . but it seems desirable to point out here that quality must be clearly defined and held nearly constant or rate of response cannot be measured accurately. Speed and accuracy are each variable factors in achievement and performance. Test exercises designed to measure speed or rate of response must present a well-defined activity with appropriate standards. When the pupil can do the activity and meet the required standards, then he is ready to take the test to see how rapidly he can do the problem.
>
> In the construction of exercises designed to measure rate or response the following principles should be observed:
>
> 1. Define the exact work to be done.
> 2. Give definite standards.
> 3. Give the pupil a chance to achieve the standards and learn exactly what they are.
> 4. Do the job on a carefully controlled time basis.
> 5. Score on the basis of known quality and time. (12, page 121)

Advantages of the Objective Tests. The objective type tests have several general advantages. The two most important advantages are answers to the two major criticisms of the essay examination -- subjectivity of scoring and limited sampling. These and other advantages will be discussed briefly.

a. Objectivity of scoring. In an objective test the questions are stated so that the answers are brief, and only one correct answer is possible. A highly objective test may be scored by a number of examiners repeatedly, with practically no disagreement in the scores assigned.

b. Extensive Sampling. Another advantage is that objective tests permit a wide sampling of the student's knowledge. A test made up of a hundred or more short well selected questions will give a more adequate index of the student's achievement than will a few questions. With such a large sampling the questions should be arranged on the basis of difficulty with the easier questions placed first.

c. Economy of Time. The form in which the objective questions are stated allows the student to state his answers briefly and in the shortest possible time. By making use of simple test scoring keys the teacher can conserve his time and yet measure the student's knowledge.

d. Elimination of Bluffing. The fact that one student can write more fluently than another does not mean he should receive the highest grade in his class. The objective test eliminates the bluffing or writing around the subject by reducing the answers to the test questions to concise, minimum answers.

Emanuel E. Ericson makes the following statement on the advantages of objective tests in industrial arts.

> The arrival of objective tests has solved the problem of how to measure pupil progress without being forced at the same time to measure his linguistic and writing ability. This type of test differs from the essay form chiefly in that a much wider field of material is covered by questions or statements, which are so arranged that the student can respond in a minimum amount of time by checking or by writing a single word or statement. (7, page 206)

Louis V. Newkirk and Harry A. Greene make the following statement concerning objective tests.

> Properly constructed objective-test exercises are not influenced appreciably by the conflicting factors which appear to invalidate measurement based on the essay-type question. Objective exercises are marked by two important and related features. These are (1) brevity of pupil response, and (2) absence of personal judgment in scoring the test exercises. (12, page 11)

Disadvantages of Objective Tests. Objective tests, although properly constructed, do have a number of rather important criticisms. The following, while not complete, probably contains the most significant of the disadvantages.

a. Overemphasis upon Factual Knowledge. Objective tests deal largely with factual information. Because the tests measure only factual information, they avoid any demands on the student for reasoning or judgment. However the essay-type questions are also based on memory and test for the factual aspects of the subject.

b. Encouragement of Guessing. Some critics feel that there is a tendency for the objective test to encourage guessing. This type does permit

but does not necessarily encourage, guessing. However, if a sufficient number of alternate responses are available, this will not be true.

c. No Opportunity for Organization of Thoughts or Expressions. The brief answers required in the objective examinations provide no opportunity for the organization of the students thoughts or expressions. Yet it is difficult to conceive how much beneficial training results during the brief period of time the students are exposed to the essay test. Slow readers or writers are penalized on the essay-type examination. The big question among critics seems to be whether a student should be allowed to write lengthy tests, no matter how poor English or incorrect information is involved, or whether the opportunity for pupil self-expression in writing can and should be provided adequately elsewhere in the school.

With the general advantages and dis-advantages of objective tests in mind, the teacher must decide whether or not the objective tests will serve adequately as the measuring instrument in his classroom and shop. Most teachers are interested in methods which will help to increase the effectiveness of the teaching. From the standpoint of improving instruction, the various types of objective tests are probably one of the most effective devices that may be used.

Standardized Objective Tests. A standardized test is a test which is constructed so that (1) it is composed of exercises which have been selected in the light of current curricular content and teaching, (2) these exercises have been statistically evaluated as to innate difficulty, and (3) the test itself is accompanied by norms permitting the interpretation of the results of pupil reactions to the test in terms of levels of accomplishment. The test is standardized by being given to a large number of children, usually unselected, and the results summarized in terms of averages and variations from

the averages for each group of children. The resulting norms may be calculated either in age norms, grade norms, or percentile norms. Age norms are tables representing typical or average performance on standardized tests for pupils in different age groups. Grade norms are tables of value representing typical or average performance on standardized tests for pupils of different grades. Percentile norms are tables of values representing percentile ranks of scores on standardized tests for certain subjects or certain grades.

The standardized test, because it is intended for use in many different types of courses of study and mainly used for general comparisions of schools with schools, class with class or city with city, should not be used as a basis for the assignment of class marks in any subject. If they are used to assign class marks, the course of study must be built around the tests.

John F. Friese defines standardized tests as follows:

> Standardized tests are usually printed. They have been carefully constructed, tested, sometimes revised, and norms have been established on the basis of many cases of wide distribution. (8, page 173)

Louis V. Newkirk and Harry A. Greene say:

> A test is standardized (1) if it is composed of exercises that have been selected in the light of usual teaching practices and evaluated as to innate difficulty, and (2) if it is accompanied by norms or standards permitting the interpretation of results in levels of accomplishment. (12, page 13)

Standardized tests are much more common in general or academic education than in industrial arts. In industrial arts, the instructor will have to rely on informal objective tests as suitable standardized tests covering all the various aspects of the field are not available. Some standardized tests have been developed in drafting, woodwork and home mechanics, but much more research and work is needed before adequately prepared standardized tests will be available for industrial arts teachers.

Advantages of Standardized Tests. Standardized tests have two distinct

advantages over other tests. These are: (1) ordinarily, they are more carefully constructed than are other tests, so fewer errors in measurement occur; and (2) all standardized tests possess norms which are valuable for student comparison.

Informal Objective Tests. Informal tests are those tests made by a teacher to meet his particular requirements and are modeled after standardized tests. Although the informal test is modeled after the standard test, its test exercises are selected directly from the course of study used by the individual teacher. Usually no norms are available for the informal test except those the teacher may have developed by recording student's grades from year to year. An informal test may become standardized after the test has fulfilled the standardization criteria.

Informal tests are well suited for testing in the field of industrial arts in measuring achievement and diagnosing instruction in the shop. They are also useful because of the differences in backgrounds of the students as to their previous experiences and differences of equipment and materials usually found in the shop.

F. Theodore Struck says in his book:

> Most tests used by teachers are of this type. These tests are similar to standardized tests, but differ from the latter in that norms have not been made available for them. Their validity and reliability usually have not been determined scientifically.
>
> On the other hand, objective, teacher-made tests are very useful. They can be easily adapted to the local requirements, and they may be more fair or valid than a standardized test in that they may better cover what was actually taught. (24, page 427)

Raleigh Schorling has the following to say about informal objective tests:

> The phrase "non-standardized" or informal test usually refers to a test constructed by the teacher in which the newer testing techniques are employed. (20, page 219)

Summary. The two general classifications of educational tests are the

essay or subjective test and the objective or New-type of test. The essay or subjective test is the traditional type of test in that up until the objective type test came into use, it was the type test used by teachers. It has been found that the essay test has two disadvantages. The disadvantages are: limited sampling and subjectivity of scoring. The traditional essay test usually consists of a limited number of questions, consequently the sample obtained from the students' responses are representative of only a few of the important areas in which the student should be tested. The type of response given by the student permits the teacher to rely too much on personal opinion when scoring the student's test. The essay type test, if used in the shop, should be made as objective as possible. The type of essay tests which may be used are simple recall, comparison of two objects, description and procedure.

The objective type test which may consist of recall, recognition, performance or a combination of all three types of tests have proven to be more satisfactory to the industrial arts teacher than the essay test. The industrial arts field is so large and varied, through the use of objective tests, the teacher may cover a wide sample of information. Because of the types of responses given, the test eliminates the teacher's personal opinion from entering into the final score. The answers to the questions are either correct or incorrect. Objective tests may be standardized or teacher made informal tests. The standardized test is a test for which the exercises have been carefully selected and evaluated and is accompanied by norms. The teacher made informal tests are made by the teacher to test in his own local situation.

Each of the types of tests has its own peculiar characteristics, advantages and dis-advantages. The teacher must determine which will best serve as the measuring instrument in his shop or classroom.

CHAPTER IV

EVALUATIVE CRITERIA OF A GOOD TEST

The selection of a standardized test, or the construction of an informal objective test or an essay test for any shop testing situation requires a careful consideration of the characteristics of a good test. A good test must possess the following characteristics: validity, reliability, objectivity, administrability, scorability, norms and standards, and economy. If the teacher understands these characteristics, the selection and construction of tests which are suitable for the testing situation at hand, will be determined much more effectively.

Validity. Validity is the most important characteristic of a good test. Unless a test is valid it serves no useful function. The validity of a test depends upon the efficiency with which it measures what it is supposed to measure. If the test includes in its content, materials commonly taught in the given subject field at the given grade level, and when it includes those things commonly stressed in that subject field and school grade, it possesses some validity. The test's validity may be determined statistically by comparing the scores yielded by a standardized test that has already been validated and a test in the same subject matter field and grade level. If there is a high degree of agreement between the two scores, the test of unknown validity is said to be valid because of the agreement of its scores with those yielded by the valid test.

Henry L. Smith, and Wendall W. Wright have the following to say about the validity of a test.

> A test is valid if it measures what it purports to measure . . . is it consistent with the objectives of education, with the objectives of the subject, with the content of the course of study, with the best practices in teaching. (21, page 33)

Reliability. Reliability is synonymous with consistency or accuracy of measurement. A test is said to have reliability if it measures consistently what it is supposed to measure. A test may be reliable without being valid but it cannot be valid unless it is reliable. When a test is administered two times within a short period of time, the resulting scores must be equivalent to a high degree for the test to be reliable. Either the same test or a duplicate and equivalent test must be used for each retesting. If, however, the scores for the two tests differ greatly for the same pupils, this test has low reliability. Tests should have a reliability coefficient of .80 or above to be of any value.

The reliability of a test may be increased either by careful selection of the test items and by a more adequate sample of the subject matter to be tested.

Louis V. Newkird and Harry A. Greene have the following to say about reliability of tests.

> The reliability of a test may be thought of as the consistency with which it performs. (12, page 24)

Objectivity. A test is objective when the teacher's personal judgment does not affect the scoring of the test. The need for the removal of the subjective factor in the marking of tests was recognized early in the growth of the testing movement. This recognition was one of the major factors which led to the development of the standardized and informal objective tests. Objectivity in a test helps eliminate personal opinion, bias, or judgment of the person who scores it. The test should be objective in giving and scoring; it should give precise and complete directions concerning its administration and accurate scoring keys.

Louis V. Newkirk says in his book:

> A test is highly objective when the personal bias has been excluded in scoring the answers. The less writing the pupil has to do, the more objective the test. Complete objectivity is obtained where the pupil simply underlines one response out of a number presented; checks or writes "true" or "false"; inserts the number of the correct response; and the like (11, page 173)

Administrability. Ease of administration should be evaluated from two points of view. First, the administration of the test from the standpoint of the student must be considered. All instructions for taking the test should be clear, simple, direct, and should appear on the test itself. In most cases the written instructions should be supplemented by other instructions given orally by the teacher. If a specific type of response is called for, this should be illustrated clearly on the test by one or more samples. In the second place, the test should not require elaborate preparation on the part of the teacher. The instructions should be so written that the instructor can administer each test under standard conditions.

The mechanical features of a test frequently affect its ease of use in the classroom. Features such as; illustrations, which whould be clear-cut and easily identified; paper of good quality, preferably white bond; page size, the length of the line, and the size of the type may limit the administrability of the test.

F. Theodore Struck has the following to say about the administration of tests.

> "Ease of administration", broadly interpreted, includes the ease with which the test is prepared, given, and interpreted. Some tests, like "multiple-choice", are relatively difficult to prepare but easy to give and score. Others, like the essay type are easy to prepare and hard to score. (24, Page 434)

Scorability. The responses of a test should be able to be scored in a simple and direct manner. Various methods have been devised to increase the

ease of scoring tests. Among these methods are the use of prepared keys, the use of separate answer sheets to be scored by hand, and the use of separate answer sheets to be scored by a machine.

The scoring key, the method which the industrial arts teacher will probably find most practical for scoring his shop tests, should be arranged so that easy and accurate scoring of the test can be accomplished. Properly spaced answers on the scoring keys can be prepared by filling out the correct answers on a copy of the test and converting it into a set of strip keys, cut out stencils or a combination of the two, according to the nature of the parts of the test.

Henry Daniel Rinsland says:

> The very heart of an objective test is the method of scoring. Often the only difference between a subjective test and an objective test is the method of scoring. Perfect objectivity exists when many people can score the same test and get exactly the same number of points. A key of answers, which must contain all possible correct answers, must also specify what is counted and how much. (15, page 269)

Norms and Standards. It is highly improbable that the industrial arts teacher will have norms for his informal tests. But any standardized tests used will be provided with norms. Practically all of the present day tests are provided with norms rather than standards.

Although norms and standards are sometimes used as synonyms, they are not identical in meaning. Norms are the levels of achievement which typical students actually attain. The term standard, when used to refer to a level of pupil achievement, implies an ultimate goal to be achieved.

The results obtained by the teacher from the scoring of a test must be interpreted by comparing them with some standard. This standard called a norm, is a table of information used in the interpretation of the test scores. The norms are obtained by giving a particular test to a large and representative sampling of students in the types of situations the test is expected to

be used.

For the purpose of interpreting test scores, various types of norms are given, such as age norms, grade norms, and percentile norms. These types of norms were discussed earlier in this report in Chapter III, page 29 . The more methods a teacher has to interpretate the test scores, the more meaningful the scores can be made if as many types of norms accompany the test as possible.

Economy. Economy, although not one of the major factors of a good test, must be considered. Teachers will find that all cheap tests are not economical forms of testing. The teachers will also find that costly instruments and methods are not necessarily the best. If two tests are being considered, one costing one dollar per hundred copies with a low reliability and limited validity, and the other costing five times as much but yields a high reliability and validity, then the latter test should be used. Perhaps the cost of testing should, in the long run, be computed in terms of the validity of the test per unit of cost.

There are many devices by which the costs of testing can be kept low without reducing the effectiveness of the measuring program. Informal objective tests can be prepared by using the mimeograph or one of the many other means of reproduction available to the instructor. The saving of time made possible by the use of scoring keys results in financial saving. Cooperative testing programs operating under institutional or public educational auspicies in many states offer testing services to schools at cost or at very low rates. Therefore, an effective testing program need not depend upon great financial outlay by the teacher or the school.

Louis V. Newkirk and Harry A. Greene say:

> In the final analysis, any test which takes up class time may be counted expensive . . . It is not at all unlikely that in the near future educational tests will be evaluated in terms of the

> of the number of units of valid and reliable information yielded per unit of cost. (12, page 39)

Test Rating Scales. In the discussion of criteria for tests in the first part of this chapter, no attempt was made to evaluate in a definite manner any of the items such as the validity, reliability, administration, scoring and interpretation which appear to affect the quality of a test. The assignment of point values to the different features of a good test is a purely subjective procedure. It is obvious that two different individuals using the evaluation chart could not be expected to agree closely in the point scores assigned to a particular test. However, in spite of this limitation, such rating scales are of very real value to the inexperienced teacher because attention is called to the quality features of a test.

Louis V. Newkirk and Harry A. Greene have the following to say about test rating scales.

> These scales are useful to all teachers in selecting tests but are especially valuable to the inexperienced teacher until he becomes accustomed to judging the different items. (12, page 40)

The accompanying reproduction of the "Otis Score Card for Rating Standardized Tests" indicates the weights assigned to the various criteria of a good examination.

Summary. Teachers should be very careful in the construction and selection of tests used in the classrooms. A good test should possess the following characteristics: validity, reliability, objectivity, administrability, scorability, norms and standards, and economy. Validity is the efficiency with which the test measures what it is supposed to measure. Objectivity is obtained when the teacher's personal judgment does not affect the scoring of the test. Administrability is the ease with which the test is given by the teacher and taken by the student. Scorability is the ease with which the test is scored. Scoring keys of different types should be used. Norms are

the levels of achievement which students actually attain. Standards imply ultimate goals of achievement. Norms may be given by ages, grades or percentiles. Tests should be economical of time and money to be good, usable tests.

OTIS SCALE FOR RATING STANDARD TESTS

Scale for Rating Tests	Names of Tests			
Manual (5)				
Validity (15)				
Reliability (10)				
Ease of Administration (Total 15) (a) Preparation (4)				
(b) Time limits (4)				
(c) Explanation needed (3)				
(d) Alternative forms (4)				
Ease of Scoring (Total 15) (a) Objectivity (10)				
(b) Time required (3)				
(c) Simplicity (2)				
Ease of Interpretation (Total 15) (a) Norms (5)				
(b) Directions for interpreting (4)				
(c) Class record (1)				
(d) Application of results (5)				
Convenient Packages (5)				
Typography and Makeup (5)				
Test Service (10)				
Reputation (5)				
TOTAL (100)				

CHAPTER V

AVAILABLE STANDARDIZED TESTS FOR INDUSTRIAL ARTS

Standardized tests have an important place in the industrial arts instruction and planning. The tests may be used to furnish important information about the student's abilities and provides the instructor with a basis for an intelligent comparison of students progress with other students doing comparable work, classes with classes or schools with other schools. They, also, may be used as a medium of arriving at standards as to information and skills in the industrial arts planning and show the quality of instruction.

By using standardized tests before beginning a course, the instructor may determine any special abilities, information or skills possessed by the student enrolled in the industrial arts course. Tests given during the course improve the instruction in that they may indicate what the instructor needs to retaach and diagnose any student difficulties which might not become apparent to the instructor, or even the student, by any other means. Tests given at the end of the course will reveal information on the student's achievement and comparison of students work with other students. Standardized tests are being used to a much greater extent in student guidance programs in modern secondary schools. This in itself should interest the industrial arts instructor as he has a definite place in guidance work.

The remaining part of this chapter gives a number of standardized tests which may be used in industrial arts. These tests are available to any instructor in industrial arts by writing any of the commercial testing bureaus found in the appendices of this study. Each test is accompanied with an annotated bibliography as to its purpose. This list, although not complete

will acquaint the teacher with some of the tests he may use.

A. Achievement Tests

Mechanical Drawing.

Badger, Alex J., A series of Standardized Tests in Fundamental Mechanical Drawing, Tests 1 and 2, Public School Publishing Company, Bloomington, Illinois. 1929. These tests are limited to drawing fundamentals. They are tests of what the pupil knows about the phases of drawing covered rather than a test of his drawing ability measured in terms of neatness, accuracy, lettering, etc.

Fisher, Ferdinand A. P., Mechanical Drawing Tests, 1, 2, and 3. The Bruce Publishing Company, Milwaukee, Wisconsin. 1930. Due to the great difference in time, method of instruction, and instructional material employed, these tests are arranged in their order of difficulty and based on the fundamental principles which typify the skill and abilities to be derived from a study of mechanical drawing. These test units such as, use of instruments, lettering, projection drawing, geometric constructions and, pictorial representations.

Quinlan, Charles Jr., Reading Problems in Mechanical Drawing, Charles A. Bennett Company, Inc. Peoria, Illinois. 1939. These tests, a series of eight tests, are reading problems in mechanical drawing on missing views, full sectional views, half sectional views and cutting planes.

Schoonover, Charles Jr., Mechanical Drawing, Bureau of Educational Educational Measurements, Kansas State Teachers College, Emporia, Kansas. 1937. The test is constructed for use as an achievement test in high school mechanical drawing classes which have a one-year course on the subject. The test covers: lines, angles, dimensioning, duplication, instruments and materials, types of drawers, identification and vocabulary.

Electricity

Caldwell, C.W., and others, Test for Electricians, Science Research Associates, Chicago, Illinois. 1942. The Test for Electricians is designed to aid industry and vocational schools in determining the amount of knowledge of electricity and electrical operations possessed by applicants or students.

Foundry

Fowler, R.W., The Fowler Foundry Test, Lafayette Printing Company, Lafayette, Indiana. 1929. To be used as a pretest, to determine the extent of the student's knowledge in foundry work before instruction and to determine achievement in the work of the course after its administration.

Woodwork

Benge, Eugene, Perceptual Mechanics Test, Management Service Company, Philadelphia, Panna. 1938. This test includes incomplete pictures of 50 ordinary mechanical objects. The student is to visualize the complete object as a whole and identify it by its common name.

Bedell, Earl L., and Ernest G. Gardner, Household Mechanics Test 3 Form A, and Form B, International Textbook Compnay, Scranton, Pennsylvania. 1938. These tests are over tools and information common to woodworking and metal working.

General

Sullivan, Elizabeth T., Wills W. Clark, and Ernest W. Tieggs, New California Short-Form Test of Mental Maturity, California Test Bureau, Los Angeles, California. 1937. This is a diagnostic test of mental maturity, designed for use in senior high school, in college, and with adults as well as in business and industry. The test consists of both language and non-language test situations.

B. PROGNOSTIC TESTS

General

Baker, Harry J., and Paul H. Voelker, Detroit General Attitudes Examination, Form A, The Public School Publishing Company, Bloomington, Illinois. 1941. In this new examination three kinds of aptitudes -- intelligence, mechanical and clerical -- are included within the test booklet. Tests are both verbal and non-verbal.

Mechanical Aptitude

Baker, Harry J. and Alex C. Crockett, Detroit Mechanical Aptitudes Examination for Boys, Public School Publishing Company, Bloomington, Illinois. 1928. The Detroit Mechanical Aptitudes Examination for Boys has been developed to measure general mechanical aptitudes or abilities by the group method and with as great accuracy and reliability as seems possible at the present time.

Bennett, George K., Test of Mechanical Comprehension, Form AA, The Psychological Corporation, New York, New York. 1940. The Test of Mechanical Comprehension measures the ability to perceive and understand the relationship of physical forces and mechanical elements in practical situations.

Case, Harry W. and Floyd Ruch, Survey of Space Relations Ability, Form A and Form B, California Test Bureau, Los Angeles, California. 1949. The Survey of Space Relations Ability was designed to measure the ability of the employee, applicant, student, or other individual to perceive rapidly and accurately the relationships among objects in space.

King, Joseph E., Factored Aptitude Series. Tests on Tools, Precision, Dexterity, Blocks, Motor, Dimension, Parts, Mechanical Terms, Differences. Industrial Psychology, Inc. Chicago, Illinois. 1948. These tests are used in relating aptitudes to interests.

Kobal, Andrew and Wayne J. Wrightstone, Mechanical Aptitude Test, The Acorn Publishing Company, Rockville Centre, New York. 1945. These tests are designed to serve in determining individual differences in mechanical aptitudes. The results from validating these tests indicate that they successfully measure potential learning ability for skilled trades.

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Lee, Edwin A., and Louis P. Thorpe, Occupational Interest Inventory -- Advanced Series, California Test Bureau, Los Angeles, California. 1943. This Occupational Interest Inventory, as its title suggests, is an inventory of occupational interests and not a test of occupational abilities or skills. It is a means of discovering and using the interests of the individual as they contribute to educational and vocational guidance.

Strong, Edward K. Jr., Vocational Interest Blank, Stanford University Press, Stanford University, Palo Alto, California. 1930. Because of the accuracy with which they indicate the likelihood of success in a given field, these are the most thorough scales of this type available. For the men's blank scoring scales are available for 36 vocations, and for the women's blank, for 17 vocations.

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Materials Furnished With the Tests Reviewed.- Such materials as a manual of directions, scoring key, class norms and test blanks commonly accompany standardized tests. These materials should be consistent with all standardized tests if the total job is to be well done. Unfortunately, publishers of standardized tests are not uniform with the materials furnished, so the results may not be interpreted properly. Some of the tests reviewed by the author gave very complete information on how to use the tests and interpret the results obtained. Other tests were composed only of the test blanks. The more information furnished with the test the easier it will be for the

instructor to determine which would be the correct test to use.

The author has listed the materials that the instructor will receive with each test in the following table. The materials given are the test, manual, validity, reliability, administration, score key, norms and interpretation. Each item furnished with the test in question is indicated with the symbol "x"

SUMMARY

Many of the standardized tests available to industrial arts teachers are very satisfactory, but the field seems to be limited almost entirely to mechanical drawing and mechanical aptitude tests. Most of these tests are what might be considered pioneer tests. Tests in woodworking and similar fields of industrial arts have been available but are now out of print. The lack of standardized tests in industrial arts may be attributed to: (1) lack of knowledge of available tests and their use by industrial arts teachers, (2) the fact that in the subject content of industrial arts, there are many testing situations which may be tested much easier by informal tests constructed by the teacher, and (3) the fact that commercial testing companies are not finding standardized tests for industrial arts subjects economical to print. The author, from his studies, could not determine why there are not more tests available, but realizes the need for more and better quality tests for areas such as the general shop and woodworking.

There is much opportunity for the development of quality tests in industrial arts that will test the legitimate expected outcomes of the informational as well as the manipulative skills. In some phases of this work new tests are being developed. A number of new tests have, in the past several years, been printed in the "Industrial Arts and Vocational Education Magazine." These

tests are not standardized tests. But, if well constructed, could be standardized by use and constant revision and prove of value in industrial arts measurement.

MATERIALS FURNISHED WITH TESTS

	Test	Manual	Validity	Reliability	Administration	Score Key	Norms	Interpretation	
Badger, Mechanical Drawing Test	X	X			X	X			
Baker, Detroit General Aptitude Test	X	X	X	X	X	X	X	X	
Baker, Detroit Mech. Aptitude Test	X	X	X	X	X	X	X	X	
Baker, Self-Analysis Inventory	X	X	X	X	X	X		X	
Bedell, Household Mechanics Tests	X				X				
Bell, The Adjustment Inventory	X	X	X	X	X	X	X	X	
Benge, Perceptual Mechanics Test	X				X				
Bennett, Mechanical Comprehension	X	X	X	X	X	X	X	X	
Caldwell, Test for Electricians	X	X	X	X	X	X	X	X	
Case, Survey of Space Relations	X	X	X	X	X	X	X	X	
Cleeton, Vocational Interest Test	X	X			X	X		X	
Fisher, Mechanical Drawing Test	X	X	X	X	X	X	X	X	
Fowler, The Fowler Foundry Test	X	X	X	X	X	X	X		
King, Factored Aptitude Series	X	X			X	X		X	
Kobal, Mechanical Aptitude Tests	X	X	X	X	X	X	X	X	
Kuder, Kuder Preference Record	X	X	X	X	X	X	X	X	
Lawshe, Purdue Industrial Test	X	X	X	X	X	X	X	X	
Lee, Occupational Interest Inventory	X	X	X	X	X	X	X	X	
Likert, Revised Minnesota Paper Test	X	X	X	X	X	X	X	X	
McQuarrie Test for Mechanical Ability	X	X	X	X	X	X	X	X	
Mellenbruch, Mechanical Aptitude Test	X	X	X	X	X	X	X	X	
Miller, Survey of Mechanical Insight	X	X	X	X	X	X	X	X	
Miller, Survey of Object Visualization	X	X		X	X	X	X	X	
Mitchell, Drawing Aptitude Test	X	X			X	X	X	X	
O'Rourke, Mechanical Aptitude Test	X	X			X		X	X	
Quinlan, Reading Problems in Mech. Drawing	X				X				
Richardson, SRA Mechanical Aptitudes	X	X	X	X	X	X	X	X	
Schoonover, Mechanical Drawing	X	X		X	X	X	X	X	
Stenquist, Stenquist Mechanical Aptitude	X	X	X	X	X	X	X	X	
Strong, Vocational Interest Blank	X				X				
Sullivan, New California Short Form Test on Mental Maturity	X	X	X	X	X	X	X	X	
Thurstone, Vocational Guidance Tests	X	X			X	X	X	X	
Wrightstone, Prognostic Test of Mechanical abilities	X	X	X	X	X	X	X	X	

CHAPTER VI

SUMMARY AND RECOMMENDATIONS

Tests and measurements in industrial arts have in the past several decades been too subjective. This method of measurement seems to have originated when man picked his first berry or made his first weapon. His own personal judgment determined whether the berry was good or bad or whether the weapon was to be used in war or to obtain food. Industrial arts is not guilty of this alone as this type of testing was first started in the academic subjects and is still being used to some extent in this field of education. But industrial arts is guilty of continuously submitting its students to this type of testing when much better methods are possible and have been available since 1918. Whether this has been due to a lack of understanding of what should be tested in industrial arts, a lack of teacher interest or, a lack of knowledge by the teachers as to how tests should be constructed and used, the author could not determine in this study. All the author hopes to do is make available to teachers and future teachers of industrial arts the methods which may be used to improve the tests given in their shops and classrooms.

The recent trend in industrial arts testing and measurement has been more progressive. The trend has been away from subjective measurement and toward more objective means. If this trend is to continue the industrial arts teacher must become acquainted with and know (1) the different types of tests that may be used, (2) how to properly select and construct tests and (3) what standardized tests are available and how they may be used. The author will attempt to summarize these three points in the following paragraphs.

PART A

Summary

The measurement and evaluation of the total ability and achievement of students in industrial arts involves the use of a wide variety of tests. When these tests are classified in terms of their form and structure, two general classifications may be distinguished; (1) essay or subjective and, (2) the objective or new-type of test. The essay or subjective test is the traditional type of test, in that, until the objective type test came into use, it was the type test used by teachers. It has been found that the essay test has two major disadvantages. The disadvantages are (1) limited sampling of material for which the student is held responsible and (2) the subjectivity of scoring the final results. The traditional essay test usually consists of a limited number of questions, consequently the questions given to the students represent only a few of the important areas in which the student should be tested. The type of response given by the student permits the teacher to rely too much on personal opinion when scoring the student's test. The essay type test, if used in industrial arts, should be made as objective as possible. The types of essay tests which may be used are the simple recall, comparison of two objects, description, and procedure.

The objective test is an examination in which the scoring procedure eliminates subjective opinion and judgment. Because of the type of responses given, the test eliminates the teacher's personal opinion from entering into the final score. The answers are either correct or incorrect. The industrial arts field is so large and varied that only through the use of objective tests may the teacher cover a wide sample of information. The objective type test which may consist of recall, recognition, performance or a combination of all three types of tests have proven to be more satisfactory to the industrial

arts teacher than the essay test. Objective tests may be standardized or teacher made informal tests. The standardized test is a test in which the exercises have been carefully selected and evaluated and are accompanied by norms. The teacher made informal tests are similar in form with the standardized tests, but are made by the teacher to test in local subject matter. The major difference lies in their origin and the degree of refinement to which they have been subjected. Each of the types of tests has its own peculiar characteristics, advantages and dis-advantages. The teacher must determine which will best serve as the measuring instrument in his shop or classroom.

The teacher must have certain knowledge concerning the construction and selection of tests to be used in the classroom. A teacher without specific knowledge on test construction and evaluation is like a person who starts out for a drive without any idea as to what direction or how far he will go. If, on the other hand, the teacher has this specific knowledge and means of determining student progress, any student goals set by the teacher will more probably be attained. A good test should possess the following characteristics; validity, reliability, objectivity, administrability, scorability, norms, and standards and economy. Validity is the efficiency with which the test measures what it is supposed to measure. Reliability is the consistency which the test measures what it is supposed to measure. Objectivity is obtained when the teacher's personal judgment does not affect the scoring of the test. Administrability is the ease with which the test is given by the teacher and taken by the student. Scorability is the ease with which the test is scored. Scoring keys of different types may be used. Norms are the level of achievement which students actually attain. Standards imply ultimate goals of achievement. Norms may be given by ages, grades or percentiles. Tests should be economical of time and money to be good usable tests.

Many standardized tests are available to the industrial arts teacher in the fields of mechanical drawing and mechanical aptitude testing. However, tests for woodwork, metal work, and similar fields are very limited. Tests for these fields of industrial arts have been available at one time but are now out of print. This lack of available standardized tests in industrial arts may be attributed to: (1) the lack of knowledge of available standardized tests and their use by industrial arts teachers, (2) the fact that in the subject content of industrial arts, there are many testing situations which may be tested much easier and better by the teacher informal type of test and, (3) the fact that commercial testing companies are not finding standardized tests for industrial arts subjects economical to print. Whatever the reason may be for the lack of tests the author could only assume as this study does not try to determine the reason. But the author does realize the need for more quality tests for industrial arts areas such as the general shop and woodworking.

It should be noted in conclusion that the use of standardized or any type of test does not solve the teachers problems. The tests adequately interpreted, definitely presents to the teacher the teaching problem. It gives a diagnosis of the situation. The remedy still needs to be applied.

PART B

RECOMMENDATIONS

The recommendations made here are based upon the experience gained by the author while working on this study and as a student in the Oklahoma Agricultural and Mechanical College. These suggestions are far from being complete and should be considered with the thought in mind that they are only one individual's suggestions. The following suggestions are made by the

author with the sincere belief that they are worthy of consideration.

Problems for Future Study. Several problems for future study, in regards to tests and measurements in industrial arts, have presented themselves to the author while carrying out the research of this study. These problems are listed as suggestions for future study.

a. Additional and more extensive research on the subject of this study be attempted. The survey technique might be used to obtain information from a representative group of schools in Oklahoma as to the types of tests used in their testing program. This would give a much broader picture as to what tests are being used and what types of tests are needed.

b. Student teachers should be allowed to construct and administer informal objective tests for some specific class, either in college or high school, and score the results. The student would gain valuable experiences from actually encountering the difficulties which arise in testing situations.

c. Aptitude tests should be given to new students in industrial arts, both on the high school and college level. In classes, such as mechanical drawing, the teacher could administer the test and then work out a profile chart on each student. From the analysis of the chart the teacher could determine the student's present knowledge and difficulties. From this the teacher would know what phases of drawing would need to be stressed more than others. These and other standardized tests could be given, once or twice a year, to indicate the student's progress and achievement in industrial arts subjects.

Suggested Applications to Industrial Arts

Tests and measurement in industrial arts have always depended too much on subjective testing. There are numerous methods of improving the tests given by the teacher and the interpretation of the results obtained. The suggested

applications that are presented here are in addition to the contributions and applications which have already been made.

a. More Standardized tests should be given in industrial arts.

b. Industrial arts teachers should learn how to use and interpret standardized tests.

c. Test results should not be used solely to assign student grades. But should be used to motivate student learning, check on the efficiency of the instruction and diagnose student difficulties.

d. Tests used in industrial arts need to be constructed more objectively.

e. Teacher informal tests must be as carefully developed as the better standardized tests.

f. Individual aptitude and diagnostic tests should be given in industrial arts classes.

g. A good reference library of tests should be available to teachers and student teachers in industrial arts.

h. Tests on student personality and interests should be given from time to time.

i. A complete, bibliography of available tests and their sources should be furnished to all prospective teachers.

A study of this nature cannot be considered as complete and final. Industrial arts is continuously undergoing changes in the subject content being taught. Testing programs should also change to meet the teachers and student needs. This study has shown the changes which have been made thus far in industrial arts testing. This study should stimulate those who are interested in and working in industrial arts, to make further studies on this subject.

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OKLAHOMA INSTITUTE OF TECHNOLOGY
of the
OKLAHOMA AGRICULTURAL AND MECHANICAL COLLEGE
School of Industrial Arts Education
and Engineering Shopwork
Stillwater

February 17, 1950

Dear Sirs:

As part of the requirements for my masters degree at Oklahoma Agriculture and Mechanical College, Stillwater, Oklahoma, I am writing a research report entitled "A Testing Program for Industrial Arts." In the report, I hope to produce as complete a list as possible of standardized tests with an annotated bibliography of each test as to what it measures and its use to the teacher.

I would appreciate the help you can give me by sending me two samples of each of the following tests listed below and your latest catalog. Any other tests or information which you may send or recomment will also be appreciated. If there is any charge for the tests, I will be very happy to pay on request. Mail all material to me in care of the School of Industrial Arts Education and Engineering Shopwork.

If you desire a summary of this report, I will be happy to forward it on to you. May I hear from you soon?

Yours very truly,

/s/ Donald W. Vest

Donald W. Vest

Approved:

/s/ C. L. Hill

C. L. Hill, Adviser
Associate Professor
School of Industrial Arts Education

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5. Bureau of Publications, Teachers College, Columbia University, New York 27, New York.
6. California Test Bureau, 5917 Hollywood Boulevard, Los Angeles 28.
7. Center for Psychological Service, George Washington University, Washington 6, D. C.
8. Co-operative Test Service, 15 Amsterdam Avenue, New York 23.
9. Educational Test Bureau, 720 Washington Avenue, S. E., Minneapolis. 14
10. Houghton Mifflin Company, 2500 Prairie Avenue, Chicago 16, Illinois.
11. Industrial Psychology, 105 West Adams Street, Chicago 3, Illinois.
12. Management Service Company, 3136 North 24th Street, Philadelphia 32, Pennsylvania.
13. Marietta Apparatus Company, Psychological Equipment, Marietta, Ohio.
14. McKnight and McKnight, 109-11 West Market Strett, Bloomington, Illinois.
15. Psychological Corporation, 522 Fifth Avenue, New York 18.
16. Public School Publishing Company, Bloomington, Illinois.
17. Science Research Associates, 228 South Wabash Avenue, Chicago 4.
18. Sheridan Supply Company, P.O. Box 837, Beverly Hills, California.
19. Stanford University Press, Stanford University, California.
20. Stoelting Company, 424 North Homan Avenue, Chicago 24, Illinois.
21. University of Minnesota Press, Minneapolis 14, Minnesota.

22. World Book Company, 2126 Prairie Avenue, Chicago 16, Illinois.

23. Dr. Karl Holzinger, University of Chicago, Chicago, Illinois.

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